A new tool for tungsten exploration – Application of scheelite fingerprinting to assess tungsten mineralization in the Eastern Alps, Austria

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Tungsten is a raw material in demand with great economic and strategic importance for the European industry, but with an increased supply risk. Accordingly, tungsten is listed by the EU Commission as critical raw materials for the EU 2020. To guarantee secure supply for Europe, it is important to explore the national raw material potential more intensively, in order to enhance strategic autonomy. Europe's largest producing tungsten mine is the world-class Felbertal scheelite deposit in Austria. Its discovery in 1967 triggered substantial greenfield exploration during the 1980s and led to the discovery of many non-economic tungsten occurrences in the Eastern Alps. “W Alps” is a joint project between the Geological Survey of Austria, Montanuniversität Leoben and Wolfram Bergbau und Hütten AG. It aims to establish assessment criteria (“fingerprints”) for the evaluation of regional tungsten potentials in Austria, which can be used in mineral exploration. So far, our data base includes field-based and analytical data of 17 tungsten occurrences. The mineralogical and chemical signatures of the economically most important Felbertal deposit will be used, together with those from the other scheelite occurrences, as indicative for tungsten endowment. Scheelite ($CaWO_4$) is the most common tungsten mineral in the Eastern Alps occurring in different geological settings and mineralization styles. Scheelite is studied using a combination of cathodoluminescence (CL), electron probe micro analysis (EPMA) and laser ablation inductively coupled plasma-mass spectrometry (LA-ICP-MS) techniques. The quest for “primary” scheelite signatures is complicated by coupled dissolution-reprecipitation and recrystallization processes during hydrothermal formation and especially subsequent regional metamorphism, causing multiple types of scheelite with different trace element composition in most deposits/occurrences. Thus, scheelite types in all occurrences were chronologically sorted by combining CL-textures and distinct trace element patterns (e.g., REE). Trace element distribution of scheelite is mainly controlled by the fluid chemistry and element fractionation between fluid and scheelite and other co-existing phases during crystallization of scheelite. It is also significantly modified during subsequent metamorphic mobilization of pre-existing scheelite. We will point out this temporal evolution of scheelite textures and chemistry and their importance for mineral exploration. Moreover, the combination of geological information and scheelite data aids to reconstruct the ore forming environment and enables the discrimination between magmatic-hydrothermal and metamorphogenic processes. This also allows to revise the current metallogenic model for tungsten mineralization in the Eastern Alps.